Technology Opportunity

Phase-Measuring, Laser Feedback Interferometry

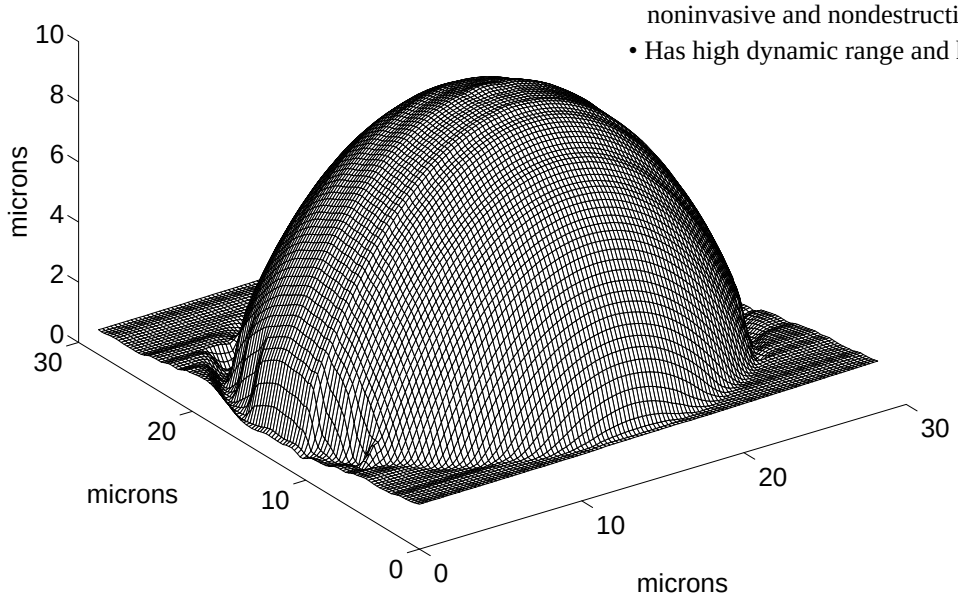
The National Aeronautics and Space Administration (NASA) Lewis Research Center has developed a phase-shifted, laser feedback interferometer and have applied this novel instrument to the measurement of piezoelectric coefficients in ceramics, profiles of static fluid drops, contact angles, and vibrational modes of oscillating drops. To produce images with high spatial resolution, we have combined the interferometer with long working distance objectives and incorporated it into a commercial microscope.

Potential Commercial Uses

- Measurement of displacements with nanometer precision
- Measurement of the piezoelectric coefficients of ceramics
- Measurement of vibrational frequencies
- Measurement of fluid physics phenomena:
  - –Location and orientation of a contact line and interface shape between two fluids
  - –Contact angles of static drops
  - –Evolution of the thickness of a thin film
  - –Deformation of a free surface due to evaporation or vibration
  - –Resonant mode shapes in bubbles
  - –Fundamental fluid parameters such as surface tension and viscosity
  - –Variations in temperature and density in a fluid
  - –Diffusion coefficients

Benefits

- Uses relatively inexpensive components and simple experimental setup.
- Requires low incident power levels and is noninvasive and nondestructive.
- Has high dynamic range and high precision.



Surface profile of a silicone oil drop on a coated, single-crystal silicon wafer obtained with LFI.

National Aeronautics and Space Administration
Lewis Research Center

The Technology

Laser feedback interferometry (LFI) differs from conventional interferometry by using the laser as both a light source and a phase detector. Either a cavity or a semiconductor (diode) laser can be used. LFI can be used in direct reflection, or the interrogating beam can pass through the sample and then be reflected into the laser. The instrument is a robust, phase-measuring device that can determine both slowly varying and dynamic phenomena over a microscopic and macroscopic field-of-view. Because the interferometer can be used to count fringes, there is no upper limit to the size of the measured displacement. In addition, the direction of the displacement can be obtained. The apparatus can accommodate both small and large working distances (many centimeters). For a microscopic field-of-view, the phase-measuring, laser feedback interferometer has been incorporated with a microscope.

Contact

Ben Ovryn, Ph. D.
NASA Lewis Research Center
Mail Stop 110-3
21000 Brookpark Road
Cleveland, OH 44135
E-mail: ovryn@wave.lerc.nasa.gov

Key Words

Phase
Laser feedback
Interferometry
Displacement
Vibration
Index of refraction

M-0239-76

National Aeronautics and
Space Administration
Lewis Research Center